Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Procedures to Govern the Use of Satellite Earth	)	
Stations on Board Vessels	)	IB Docket No. 02-10
	)	

COMMENTS OF CORNELL UNIVERSITY

Cornell University, by its attorney, hereby submits comments in response to the Commission's November 24, 2003 Notice of Proposed Rulemaking in the above-captioned docket ("*NPRM*"). In these Comments, Cornell supports the Commission's proposal, as modified below, to protect radio astronomy observations in this band with coordination requirements and with a footnote in the Table of Allocations. Cornell also urges the Commission to include in such protections, observations made at the Arecibo Observatory.

I. Background

Cornell has a substantial interest in this proceeding, as it operates the Arecibo Observatory ("Arecibo") near Arecibo, Puerto Rico. Arecibo is part of the National Astronomy and Ionosphere Center ("NAIC"), a national research center operated under a cooperative agreement with and funded by the National Science Foundation ("NSF"). The NSF is an independent federal agency whose mission is to promote scientific and engineering progress in the U.S.

As the site of the world's largest single-dish radio telescope, Arecibo is recognized as one of the most important centers in the world for research in radio

astronomy and planetary radar.[1] Though Arecibo has been operating since 1963, work was completed on a multi-million dollar upgrade to its facilities in 1997. The upgrade significantly expanded the range and sensitivity of the observations that could be made with the telescope, while at the same time it increased the shielding around the telescope to reduce interference from ground radiation. One of the primary purposes of that 1997 upgrade was to enable an immediate expansion of the frequency range of observations that could be made with the telescope, which, with the subsequent incremental upgrades that are now in progress, could be further increased to allow observations at frequencies up to 15 GHz. Cornell referenced this expansion of Arecibo's observable frequency range up to 15 GHz in its comments in ET Docket 96-2, which resulted in the Commission's creation of the Puerto Rican Coordination Zone, which applies to applicants for facilities below 15 GHz. *See*, Radio Astronomy Coordination Zone, Report and Order, 12 FCC Rcd 16522, 16527, 16529-30 (1997).

II. Cornell Supports the Protection of 14 GHz Radio Astronomy Observations, With Suggested Modifications.

In proposing rules for the operation of satellite earth stations on ships and vessels ("ESVs") at 14.0-14.5 GHz, paragraph 38 of the *NPRM* notes the use of the 14.47-14.5 GHz band by the Radio Astronomy Service ("RAS"), and in paragraph 39 the Commission proposes the creation of a footnote for the U.S. Table of Allocations that

[1] Arecibo has a long history of being the site where very significant accomplishments in astronomy have occurred, including: the first discovery of planets outside of our own Solar System; discovery of the first pulsar in a binary system, leading to important confirmation of Einstein's theory of gravitational waves and a Nobel Prize for two radio astronomers who performed their research at Arecibo (the third Nobel Prize for radio astronomy in its short 50 year history); and discovery of the correct rotation rate of the planet Mercury, as well as the discovery of ice in craters on Mercury's polar regions (and similar investigation of the polar regions of the Earth's Moon).

would require ESV operators to avoid creating harmful interference to RAS observations made at the sites currently listed in footnote US 203. The *NPRM* also proposes that ESV stations in the 14.0-14.5 GHz band be coordinated through the NTIA's Interdepartment Radio Advisory Committee ("IRAC").

Cornell supports the need to provide protection for RAS observations at 14.47-14.5 GHz. Observations at these frequencies are important to radio astronomy. In addition, it does not appear that compliance with these protection requirements will be difficult for most ESV operators, due to the large distance between most RAS observatories and large bodies of water, as well as to terrain obstacles between the locations of ESVs and observatories. However, this is not the case with regards to Arecibo. It should be noted that Arecibo is located only 14 kilometers from the northern coast line of Puerto Rico, and that numerous ships, including many cruise ships, travel in the Atlantic Ocean along that coast on a daily basis. In addition to this geographic proximity to likely users of ESVs, Cornell notes that there are no terrain obstructions between the Atlantic and the Arecibo facilities: there is a direct line-of-sight between the coast and the suspended triangle structure that carries the weight of the receivers and their feeds. Radio frequency power emitted from ships can thus scatter from the structure, down to the 305 m antenna, and thence into the radio receivers. In regards to ships sailing to the South of Puerto Rico, Arecibo is approximately 39 kilometers from the Caribbean (southern) coast, though there are mountains that provide some shielding in that direction. Nevertheless, Cornell remains concerned about possible interference coming from ships off the Caribbean coast.

The *NPRM* bases its proposal for protection of RAS facilities in part on Footnote US 203. That footnote states that while observations are made at Arecibo at 4 GHz, observations at 14.47-14.5 GHz are not currently made at that site. While it is true that Arecibo does not currently observe at 14 GHz, Arecibo is in the midst of a series of incremental upgrades that upon completion (which is expected to occur in approximately three years), will enable observations up to 15 GHz.

The first of the incremental upgrades, which involved the resetting of the 38,000 surface panels of the 305 m antenna, is largely complete. The current upgrade will reset both the secondary and tertiary reflecting surfaces, so the telescope will be capable of supporting some work at 15 GHz by the end of 2004. Nevertheless two more steps are required to fully enable observation at these frequencies, namely (i) fabrication of a cryogenic 11-15 GHz receiver; and (ii) improving the pointing accuracy of the telescope by installing a version of the laser-ranging metrology system developed at NRAO for the 100 m Green Bank Telescope: these projects should be complete by the end of 2006. Cornell accordingly supports the suggestion in Footnote 79 of the *NPRM* that the list of sites protected for RAS observations at 14.47-14.5 GHz should include Arecibo.[2]

[2] While some parties might suggest that the Commission provide protection to Arecibo only upon completion of the current upgrades, Cornell notes that doing so would require the initiation of a new rulemaking proceeding, with the filing of a petition, responsive pleadings, and comments. The burden on the Commission and on other parties would be greater in such an approach, compared to addressing it in this proceeding. Addressing the matter in this proceeding is also consistent with the Commission's discussion in paragraph 38 and footnote 79 of the *NPRM* noting that the 14.47-14.50 GHz band is available at certain observatories including Arecibo, as well as with the protection up to 15 GHz enacted by the Commission in the 1997 Radio Astronomy Coordination Zone, Report and Order.

While Cornell supports the use of footnote protection for certain observatories, it is concerned that the language in proposed Footnote U.S. xxx may not be sufficient to provide the protection sought by the Commission. Because observational data are often not reviewed on a real-time basis, if a protected observatory is experiencing interference, it may not realize the problem until the source of interference has already left the vicinity. Even when data is being read on a real-time basis, as would be possible with much of the data expected from Arecibo, it may well be difficult to identify the source vessel within the time that the interfering ship is within the vicinity, and thus it may not be possible to remedy the problem before the ship has passed. Thus, in addition to prohibiting harmful interference generally, the Commission should consider prohibiting any transmission in the 14.47-14.5 GHz range at locations visible from the observatories of concern. Arecibo is located at longitude W 66 deg. 45' 11", latitude N 18 deg. 20' 46", and at an elevation of 496 meters amsl, so the formal horizon distance for Arecibo is 92 kilometers.[3] Footnote US xxx should accordingly prohibit ESV transmissions within 80 kilometers of the Puerto Rican coast.

Cornell therefore requests the Commission to include Arecibo in the list of observatories provided with footnote protection for RAS observations at 14.47-14.5

[3] The distance to the horizon, d(km), being determined from the standard formula $d = 4.1 \sqrt{h}$, where h is the height of the antenna above mean sea level in meters.

GHz, and that ESV transmissions at those frequencies be prohibited in the area described above.

Respectfully submitted,

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February 23, 2004